Z-2 Threaded Insert Design and Testing Abstract

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The Z-2 Prototype Planetary Extravehicular Space Suit Assembly is a continuation of NASA's Z series of spacesuits. The Z-2 is another step in the NASA's technology development roadmap leading to human exploration of the Martian surface. To meet a more challenging set of requirements than previous suit systems standard design features, such as threaded inserts, have been re-analyzed and improved.

NASA's Z-2 prototype space suit contains several components fabricated from an advanced hybrid composite laminate consisting of IM10 carbon fiber and fiber glass. One requirement NASA levied on the suit composites was the ability to have removable, replaceable helicoil inserts to which other suit components would be fastened. An approach utilizing bonded in inserts with helicoils inside of them was implemented. The design of the interface flanges of the composites allowed some of the inserts to be a "T" style insert that was installed through the entire thickness of the laminate. The flange portion of the insert provides a mechanical lock as a redundancy to the adhesive aiding in the pullout load that the insert can withstand. In some locations it was not possible to utilize at "T" style insert and a blind insert was used instead. These inserts rely completely on the bond strength of the adhesive to resist pullout. It was determined during the design of the suit that the inserts did not need to withstand loads induced from pressure cycling but instead tension induced from torqueing the screws to bolt on hardware which creates a much higher stress on them. Bolt tension is determined by dividing the torque on the screw by a *k* value multiplied by the thread diameter of the bolt. The k value is a factor that accounts for friction in the system. A common value used for k for a non-lubricated screw is 0.2. The *k* value can go down by as much as 0.1 if the screw is lubricated which means for the same torque, a much larger tension could be placed on the bolt and insert. This paper summarizes testing that was performed to determine a k value for helicoil inserts in the Z2 suit and how the insert design was modified to resist a higher pull out tension.